

WHAT IS CLAIMED IS:

1. A method of producing a photomask in which a light-transmissive substrate is formed thereon with a chromium pattern having a global opening ratio difference in its plane on the light-transmissive substrate, said method characterized by comprising the steps of:

preparing a photomask blank having, on said light-transmissive substrate, at least a chromium film for forming said chromium pattern, an etching mask film made of an inorganic-based material having a resistance against etching of said chromium film, and a resist film;

exposing and developing said resist film with a desired pattern to form a resist pattern;

applying dry etching to said etching mask film using said resist pattern as a mask to form an etching mask pattern; and

applying dry etching to said chromium film using said etching mask pattern as a mask to form said chromium pattern,

wherein the dry etching of said chromium film is carried out under a condition selected from conditions that cause damage to said resist pattern to a degree which is unallowable when etching said chromium film using said resist pattern as a mask.

2. A method of producing a photomask according to claim 1, characterized in that the condition that causes damage to said resist pattern which is unallowable when etching said chromium film using said resist pattern as a mask is a condition that increases anisotropy of dry etching and/or a condition that increases an etchant density of etching.

3. A method of producing a photomask according to claim 1, characterized in that said photomask is a binary mask having said chromium pattern on said light-transmissive substrate.

4. A method of producing a photomask according to claim 1, characterized by further comprising a step of stripping said etching mask pattern after forming said chromium pattern.

5. A method of producing a photomask according to claim 1, characterized in that said etching mask pattern is left on said chromium pattern as a film having a reflection preventing function.

6. A method of producing a photomask according to claim 1, characterized in that said photomask is a phase shift mask and said photomask blank has a phase shift film between said light-transmissive substrate and said chromium film, and characterized by further comprising a step of forming a phase shift pattern using said chromium pattern as a mask after the step of forming said chromium pattern.

7. A method of producing a photomask according to claim 1, characterized in that said photomask is a phase shift mask and characterized by further comprising a step of patterning said light-transmissive substrate to form a phase shift groove using said chromium pattern as a mask after the step of forming said chromium pattern.

8. A method of producing a photomask according to claim 1, characterized by comprising a step of stripping, before the step of forming said chromium pattern, said resist pattern remaining in the step of forming said etching mask pattern.

9. A method of producing a photomask according to claim 1, characterized in that said etching mask film made of the inorganic-based material is made of a material containing at least one of molybdenum, silicon, tantalum, and tungsten.

10. A method of producing a photomask according to claim 1, characterized in that, in the step of forming said chromium pattern, an etching rate of said chromium film is ten or more times an etching rate of said etching

mask pattern.

11. A photomask producing method of producing a halftone-type phase shift mask in which a light-transmissive substrate is formed thereon with a light-semitransmissive phase shift pattern having a global opening ratio difference in its plane on the light-transmissive substrate, said method characterized by comprising the steps of:

preparing a photomask blank having, on said light-transmissive substrate, at least a light-semitransmissive phase shift film for forming said light-semitransmissive phase shift pattern, a chromium film for forming a chromium pattern, an etching mask film made of an inorganic-based material having a resistance against etching of said chromium film, and a resist film;

exposing and developing said resist film with a desired pattern to form a resist pattern;

applying dry etching to said etching mask film using said resist pattern as a mask to form an etching mask pattern;

applying dry etching to said chromium film using said etching mask pattern as a mask to form said chromium pattern;

applying dry etching to said light-semitransmissive phase shift film using said chromium pattern as a mask to form said light-semitransmissive phase shift pattern; and

removing a desired part or the whole of said chromium pattern.

12. A photomask producing method according to claim 11, characterized in that said etching mask pattern is stripped with the dry etching of said light-semitransmissive phase shift film.

13. A photomask producing method according to claim 11, characterized in that said etching mask pattern is left on said chromium pattern as a film having a reflection preventing function.

14. A photomask producing method according to claim 11, characterized in that said light-semitransmissive phase shift film comprises an uppermost layer made of a material containing silicon, and nitrogen and/or oxygen.

15. A photomask producing method according to claim 14, characterized in that said light-semitransmissive phase shift film is a film of a monolayer structure made of a material containing metal, silicon, and nitrogen and/or oxygen.

16. A photomask producing method according to claim 11, characterized by comprising a step of stripping, before the step of forming said chromium pattern, said resist pattern remaining in the step of forming said etching mask pattern.

17. A photomask producing method according to claim 11, characterized in that said etching mask film made of the inorganic-based material is made of a material containing at least one of molybdenum, silicon, tantalum, and tungsten.

18. A photomask producing method according to claim 11, characterized in that, in the step of forming said chromium pattern, an etching rate of said chromium film is ten or more times an etching rate of said etching mask pattern.

19. A photomask producing method of producing a chromeless-type phase shift mask in which a light-transmissive substrate is formed thereon with a light-transmissive phase shift pattern having a global opening ratio difference in its plane on the light-transmissive substrate, said method characterized by comprising the steps of :

preparing a photomask blank having, on said light-transmissive substrate, at least a chromium film for forming a chromium pattern, an etching mask film made of an inorganic-based material having a resistance against

etching of said chromium film, and a resist film;

exposing and developing said resist film with a desired pattern to form a resist pattern;

applying dry etching to said etching mask film using said resist pattern as a mask to form an etching mask pattern;

applying dry etching to said chromium film using said etching mask pattern as a mask to form said chromium pattern;

applying dry etching to said light-transmissive substrate using said chromium pattern as a mask to form said light-transmissive phase shift pattern; and

removing a desired part or the whole of said chromium pattern.

20. A photomask producing method according to claim 19, characterized in that said etching mask pattern is stripped with the dry etching of said light-transmissive substrate.

21. A photomask producing method according to claim 19, characterized in that said etching mask pattern is left on said chromium pattern as a film having a reflection preventing function.

22. A photomask producing method according to claim 19, characterized by comprising a step of stripping, before the step of forming said chromium pattern, said resist pattern remaining in the step of forming said etching mask pattern.

23. A photomask producing method according to claim 19, characterized in that said etching mask film made of the inorganic-based material is made of a material containing at least one of molybdenum, silicon, tantalum, and tungsten.

24. A photomask producing method according to claim 19, characterized in that, in the step of forming said chromium film pattern, an etching rate of said chromium film is ten or more times an etching rate of said

etching mask pattern.

25. A photomask blank serving as a base member for producing a halftone-type phase shift mask in which a light-transmissive substrate is formed thereon with a light-semitransmissive phase shift pattern having a desired opening, said photomask blank characterized in that

a light-semitransmissive phase shift film, a chromium film, and an etching mask film made of an inorganic-based material having a resistance against dry etching of said chromium film are stacked in order on said light-transmissive substrate.

26. A photomask blank according to claim 25, characterized in that said light-semitransmissive phase shift film comprises an uppermost layer made of a material containing silicon, and nitrogen and/or oxygen.

27. A photomask blank according to claim 26, characterized in that said light-semitransmissive phase shift film is a film of a monolayer structure made of a material containing metal, silicon, and nitrogen and/or oxygen.

28. A photomask blank according to claim 25, characterized in that said etching mask film is made of a material that is possible to strip with the dry etching of said light-semitransmissive phase shift film.

29. A photomask blank according to claim 25, characterized in that said etching mask film is a film having a reflection preventing function.